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Indian Standard

TEST CHART FOR UNIVERSAL MILLING MACHINES WITH A SWIVELLING TABLE

UDC 621·914·3 : 620·1 [084·3]

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

April 1994

Price Group 3

Machine Tool Basics and Modular Units Sectional Committee, PE 03

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Machine Tool Basics and Modular Units Sectional Committee had been approved by the Production Engineering Division Council.

This standard is in line with ISO 1701-1974/Addendum 1-1978 'Test conditions for milling cutting machines with table of variable height, with horizontal or vertical spindle — Testing of the accuracy, Addendum 1 : Annex — Universal milling machines with a swivelling table issued by International Organization for Standardization (ISO).

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

TEST CHART FOR UNIVERSAL MILLING MACHINES WITH A SWIVELLING TABLE

1 SCOPE

This standard describes both geometrical and practical tests on universal milling machines with a swivelling table and the corresponding permissible deviations with reference to IS 2063 : 1988 'Acceptance code for machine tools — Geometric accuracy of machines operating under no-load or finishing conditions'.

1.1 It deals only with the verification of accuracy and applies neither to the testing of the running of the machine (vibrations, abnormal noises, stick-slip motion of components, etc) nor to the machine characteristics (speeds, feeds, etc) which shall generally be checked before testing the accuracy.

2 REFERENCES

2.1 IS 2063 : 1988 'Acceptance code for machine tools — Geometric accuracy of machines operating under no-load or finishing conditions' is a necessary adjunct to this standard.

3 PRELIMINARY REMARKS

3.1 To apply these tests, reference shall be made to IS 2063 : 1988 especially for installation of the machine before testing, warming up of spindles and other moving parts, description of measuring methods and recommended accuracy of testing equipment.

3.2 The sequence in which the geometrical tests are given is related to the sub-assemblies of the machine and does not define the practical order of testing. In order to make checking or mounting of instruments easier, tests may be carried out in any convenient sequence.

3.3 It is not always necessary, when inspecting a machine, to carry out all the tests described in this standard. It is up to the user to choose in agreement with the manufacturer, only those tests which are of interest to the user, but these tests are to be clearly stated while ordering a machine.

3.4 Practical tests shall be made only with finishing cuts (for instance, depth of cut = 0·1 mm, feed/tooth 0·1 mm) and not with roughing cuts which are liable to generate appreciable cutting forces. However, the material of the test piece and the actual cutting conditions shall be determined by the manufacturer.

3.5 When establishing the tolerance for a measuring range different from that indicated in this standard (*see* **2.311** of IS 2063 : 1988), it shall be taken into consideration that the minimum tolerance is 0·01 mm. For any proportional value, the calculated value shall be rounded off to the nearest 0·005 mm. However, the least count of all measuring instruments need not be finer than 0·01 mm.

3.6 Whenever alternate methods of testing are suggested, the choice of actual method of testing is left to the manufacturer.

3.7 For the purpose of this standard, various methods of expressing permissible deviation are employed, each having a particular type of application. The methods employed are as follows:

000/000 for deviations of perpendicularity which are ratios.

000 for any length of 000 for deviations of straightness and parallelism; this expression is used in fact for local permissible deviations, the measuring length being obligatory.

000 for 000 for deviations of straightness and parallelism; this expression is used to recommend a measuring length but in this case the proportionality rule comes into operation if the measuring length differs from those indicated.

4 TESTING INSTRUMENTS

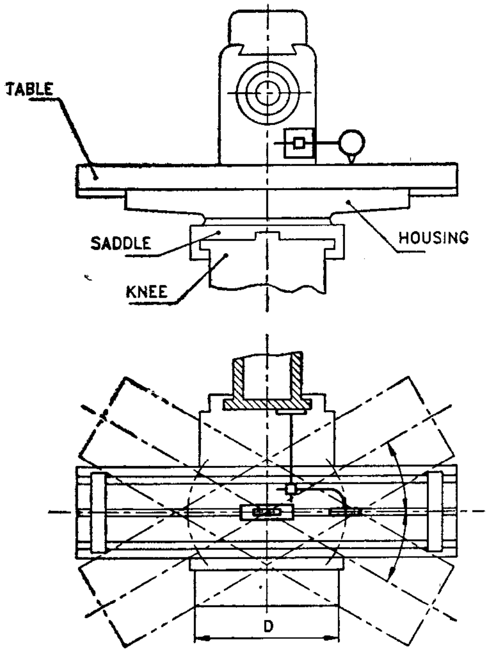
4.1 The testing instruments shall be of the approved type and shall be calibrated at a recognized temperature conforming to the relevant Indian Standards.

5 ACCURACY REQUIREMENTS

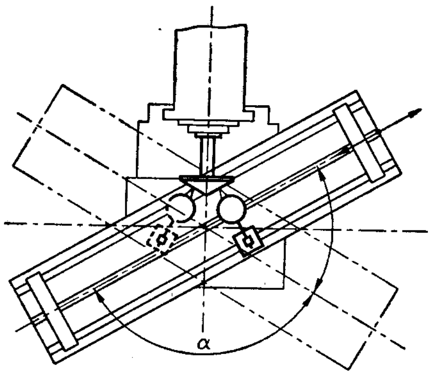
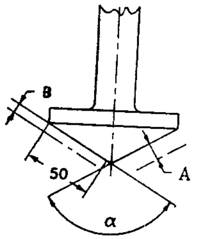
5.1 The tests to be carried out, the instruments required, the maximum permissible deviations and the manner of carrying out the tests shall be as detailed in the test chart.

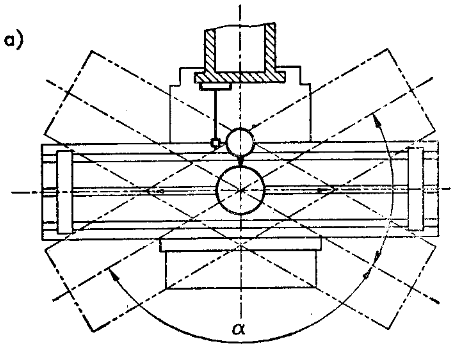
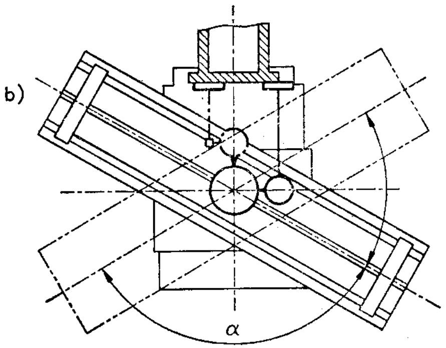
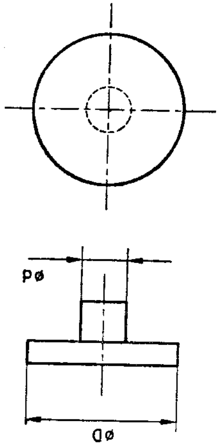
5.2 Test Conditions and Permissible Deviations

5.2.1 *Preliminary Tests*

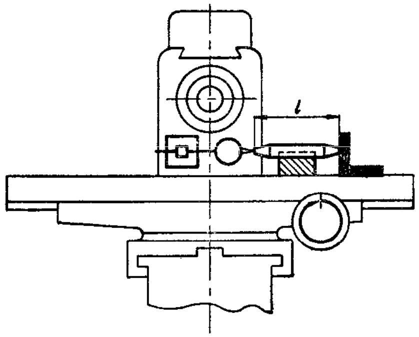
No.	Diagram	Object	Measuring Instruments	Observations and References to the Test Code IS 2063 : 1988	Permissible Deviation mm	Actual Error
0		Measurement of camming of the table surface when the table is rotated	Test mandrel and slip gauges or precision level (only if the machine has been accurately levelled).	Clauses **5.632** and **5.633** This measurement is to be taken over the total possible angular rotation of the table.	0.03 For a measuring diameter *D* of 1 000	

5.2.2 *Geometrical Tests*

No.	Diagram	Object	Measuring Instruments	Observations and References to the Test Code IS 2063 : 1988	Permissible Deviation mm	Actual Error
1		Checking that the table swivel axis and the spindle axis are in the same vertical plane.	Dial gauge, and special test mandrel fitted with a conical end as shown below : 	Knee, saddle and housing locked when taking measurements. **Method of Testing** 1 With the table set approximately in a vertical plane parallel to one of the generators of the conical face of the test mandrel, bring the dial gauge into contact with this generator and adjust the table height so that the dial gauge is in a horizontal plane passing through the axis of the test mandrel. 2 Set the table accurately in a vertical plane parallel to the generator of the conical face of the test mandrel by moving the table on its slides, the dial gauge being continuously in contact with the conical face of the test mandrel. 3 Note the dial gauge reading (reading A). 4 Without changing the position of the dial gauge turn the test mandrel through 180° by rotating the spindle, and adjust the table accurately in a vertical plane parallel to the same generator of the conical face of the test mandrel, as before. 5 Note the new dial gauge reading (reading B).	0·08 For α = 120°: Actual deviation between the two axes = (A − B) for α = 90°: Actual deviation between the two axes = $\left(\frac{A-B}{\sqrt{2}}\right)$	

No.	Diagram	Object	Measuring Instruments	Observations and References to the Test Code IS 2063 : 1988	Permissible Deviation mm	Actual Error
2	 	Deviation of the centre line of the central or median T-slot from the table swivel axis.	Dial gauges and special test disc as shown below:  *D* = 80 mm (3·2 in) min. *d* =width of the table T-slot	Saddle and the knee locked **Method of Testing** *a*)— Place the disc on the table, as near as possible to the swivel axis, its spigot *d* being placed in the median reference slot. — Set the table in one of its extreme positions corresponding for instance to α = 120° or α = 90°. — Mount the dial gauge on a fixed part of the machine, and place the stylus in contact with the edge of the disc in a vertical plane roughly containing the spindle axis and note the dial gauge reading. — Rotate the table to its other corresponding terminal position, symmetrical to the previous one, and note the new dial gauge reading	For *b*) : 0·05 DI For α = 120° : The deviation between the centre line of the central or median T-slot and the table swivel axis is equal to the difference between the two dial gauge readings. For α = 90° : The deviation between the centre line of the central or median. T-slot and the table swivel axis is equal to the difference between the two dial gauge readings, divided by $\sqrt{2}$.	

No.	Diagram	Object	Measuring Instruments	Observations and References to the Test Code IS 2063 : 1988	Permissible Deviation mm	Actual Error
				— Move the disc or the table in the longitudinal direction in order to obtain the same dial gauge readings for the two extreme positions of the table. — Mount and clamp the disc on the table. *b*) — Move the dial gauge, always on a fixed part of the machine, but this time in contacting the disc in a plane perpendicular to the previous one. — Rotate the table alternately in its two chosen terminal positions, as in *a*) and note the dial gauge readings for each of these two positions.		

No.	Diagram	Object	Measuring Instruments	Observations and References to the Test Code IS 2063 : 1988	Permissible Deviation mm	Actual Error
3		Measurement of the cumulative error on the effective lead of the feed screws: *a*) of the longitudinal feed screw, *b*) of the transverse feed screw.	Dial gauge and gauge blocks	Clause **6.114** — The displacements of the table or of the saddle shall be made by a number of full revolutions of the driving wheel or of the screw, without moving the sliding-gauges, approximating over a distance of 300 mm. — The test is to be made in three different positions along the total length of the displacement considered. — If the feed screw has been tested by more stringent methods prior to assembly, this test may be dispensed with by producing a test certificate.	*a*) and *b*) : 0·035 for l = 300	

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